

ing the necessary research permits. Dave Orr, chief, Division of Archeology and Historic Architecture, Valley Forge National Historic Park, met with park staff to discuss the concerns and review the site in an attempt to determine the limits of acceptable work that could be accomplished within the watershed without impacting the cultural resources.

After discussing the nature of the research done in Shaver Hollow, reviewing the maps of the watershed, and hiking briefly through the area, Orr, in consultation with the Virginia State Historic Preservation Office archeologist, Ethel Eaton, determined that the area of cultural resource concern was minimal and specific to areas at the top of the watershed and the lower center of the watershed where slopes were 5%\* or less. Based on this determination, we developed a set of guidelines which will allow us to continue ongoing research and approve or disapprove new research without the need for detailed archeological surveys. The guidelines consist of: avoidance of ground disturbing activities in areas with less than 5% slope; staying out of old road beds; minimizing holes to less than 3" in diameter; and dispersing holes 30' apart. Any work that would be requested on areas less than 5% slope would be reviewed for cultural resource conflicts and, if necessary, preceded by an archeological survey.

A Geographic Information System map is being developed using slope percentages which will outline areas of concern. By using this map and the guidelines, we will be able to plan future research and monitoring activities in Shaver Hollow with a greater confidence that culturally significant resource areas are being adequately protected. This effort not only insures better protection of all resources but is extremely valuable in educating the research community to be more sensitive to cultural resource areas which may not be apparent. Because of the ongoing research focus in the RNA, the park also determined that the next high priority area for archeological survey would be the Shaver Hollow watershed. This model, which integrates natural and cultural resource planning, will be extended to other areas where intense research efforts will be planned in the future.

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\* This percentage is specific to the topography of Shaver Hollow. In other park areas, 15% is the guideline for survey decisions.

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## GIS as a Preservation Tool at Shenandoah

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**M**anaging the protection and preservation of archeological resources is an important theme reflected in Shenandoah National Park's General Management Plan (USDOI, 1983), Wildland Fire Management Plan (USDOI, 1993), Mission Goals Statement (USDOI, 1996), and Backcountry and Wilderness Management Plan (USDOI, 1997). Although each addresses different levels of concern in its management objectives, all agree that these resources are at risk from both natural and unnatural causes. These same concerns are recognized throughout the park's surrounding communities, whose citizens have requested that old homesites somehow be identified (USDOI, 1995).

Supporting the park's interdisciplinary need to protect cultural resources requires understanding where these resources are located. A Geographic Information System (GIS) is an integrated mapping system which uses input and analysis of spatial features from many different sources to create efficient, accurate, and consistent map products. The GIS program at Shenandoah maintains an extensive database of information supporting all management disciplines, including natural and cultural resource management, fire management, visitor protection, backcountry management, pest management, and facilities management. Using this data, geo-relational models can be constructed by superimposing attributes that describe forest quality, ecological value, wildlife

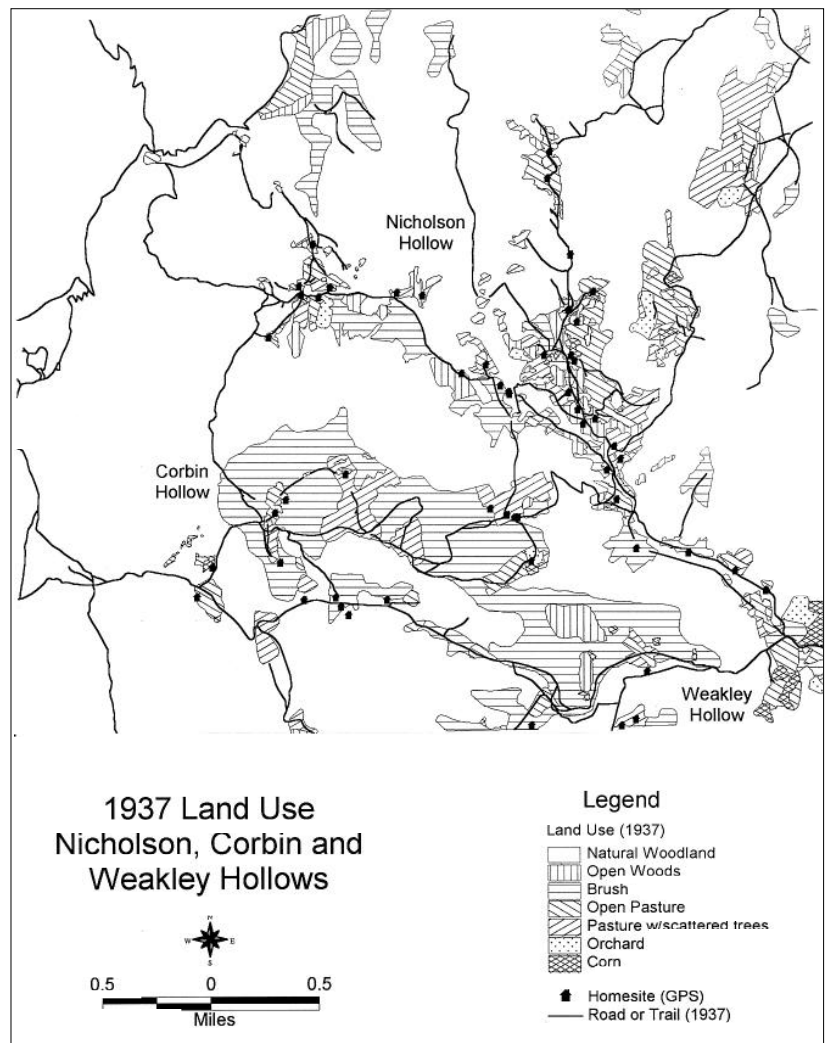
habitats, and historical and recreational sites.

Using GIS and information from trail system networks, campsite inventories, and backcountry management area boundaries, resource managers can quickly evaluate which sites with archeological or paleontological significance are at risk to aggressive users. Management might consider restricted camping and increased education in culturally sensitive areas. Using GIS, fire managers can examine fire history, forest quality, and fuel load in areas identified as culturally sensitive and plan less aggressive fire suppression tactics. However, before we can thoroughly examine these and other relationships, the spatial and non-spatial data must be entered into GIS and its associated relational database management system (RDBMS).

Initially, the GIS program at Shenandoah National Park became involved with cultural resource studies in the Corbin, Weakley, and Nicholson Hollows to document accurately the locations of historic homesites before these relics of past civilization deteriorated beyond recognition. This initial work has evolved beyond simply gathering coordinate field data toward a full GIS integration of 1937 landuse maps (Reed and Reeder, 1980), USGS quadrangle maps (1929), aerial photography (National Archives, 1937), and surficial archeological site data.

#### Methods

Global Positioning System (GPS) technology allows investigators to accurately locate, record, and transfer study site locations from the field to the desktop GIS for analysis. GPS technology takes advantage of an earth orbiting constellation of 24 satellites managed by the Department of Defense. Using proprietary mathematical algorithms, a GPS receiver receives signals broadcast from the satellite constellation and, with appropriate processing, calculates to a high degree of accuracy locations on the surface of the earth. All of the GPS data files collected during the project were processed, using Trimble Pathfinder software running on a PC workstation with a Pentium 120 processor. Processed



files were then transferred to a Sparc 20 workstation for subsequent Arc/Info, GIS layer development.

Historic homesites in the Nicholson, Corbin, and Weakley Hollows were first identified from USGS quadrangle maps (1929), court records, and aerial photography (National Archives, 1937). Using this information, 77 sites were located on the ground by investigators prior to GPS field activity. At each location, a grid was laid out in preparation for surficial archeological mapping. A bearing shot off a corner stake provided the base line for developing a site grid. Each stake location was then mapped using a Trimble Pro-XL, GPS unit. Each cell in its respective site grid was assigned a unique identifier. This identifier provides the link between data stored in the RDBMS, "what was mapped" and its spatial counterpart, "where it was mapped." This allows researchers to reconstruct in GIS the locations of relic data collected within each site grid cell and analyze the relationships between sites in the study area.

To further enhance our knowledge of this area, a 1:12,000 scale landuse map was provided by Ben Morgan of the USGS. The landuse interpre-

tation was based on a set of 1937 aerial photographs from the National Archives (Reed and Reeder, 1980). The features were digitized by the Shenandoah GIS lab and converted into discrete map layers. These layers include roads, buildings, fences, and landuse classification. Roads were further classified as automobile, wagon, foot, or horse trails. Buildings were classified as house, outbuilding, abandoned but standing in 1937, and the ruin of a building in 1937. Land uses were classified as natural woodland, open woods, brush, open pasture, pasture with scattered trees and shrubs, and orchard.

#### *Further Studies*

This winter's (1997-98) field activity will include maps with the previous season's (1996-97) homesite data overlaid with 1937 landuse. All data layers will be carried into the field on a laptop computer. Hardware and software upgrades will further enhance field study efforts. The laptop is equipped with Trimble's Aspen software. Aspen software is the interface between the GPS receiver, upgraded to a Trimble Pro-XR receiver, and the laptop PC. This allows investigators to view in real-time their location on background maps. This integration of technologies provides the capability to navigate to homesites that to date remain elusive and to document further the historic mountain culture.

A Kodak DC50 (resolution of 756 X 504 pixels) zoom and an Olympus D-300L (resolution of 1024 X 768 pixels) digital camera will each be used to photodocument stone masonry at selected sites. Digital images are stored as a record in the database and linked to GPS points in ArcView, a PC-based GIS application. ArcView allows viewing of GIS map layers and associated imagery as well as database query and analysis capability. This will allow investigators the opportunity to "revisit" a site from their desktop.

Discussions also include using a theodolite mapping system to accurately measure elevation along with GPS coordinates. Digital elevation models from this data will be developed to document evidence of slope terracing, an intensive farming practice common up many of the hollows as settlement increased in the rich bottomlands.

Cultural resource investigations in Shenandoah National Park are used to document locations with cultural significance. An extensive database of information is being generated by these investigations. This data integrated into the park's GIS will provide detailed information for cultural resource studies and assist other resource managers in their planning and decisions. Understanding where these fragile resources are located might in the end be their only salvation. Fire managers, backcountry managers, law enforcement rangers, and maintenance managers can be sensitized to this important aspect of our heritage and willingly modify their programs toward protection, preservation, and education.

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**The Shenandoah Valley Battlefields National Historic District Commission** is underway! Interior Secretary Bruce Babbitt named 19 members to the commission in late September. The commission will now begin its work to develop a plan for protecting and interpreting the historic, cultural, and natural resources associated with the Civil War battlefields and campaigns in the Valley. For further information, contact Sandy Rives, Shenandoah National Park, 804-985-7293.